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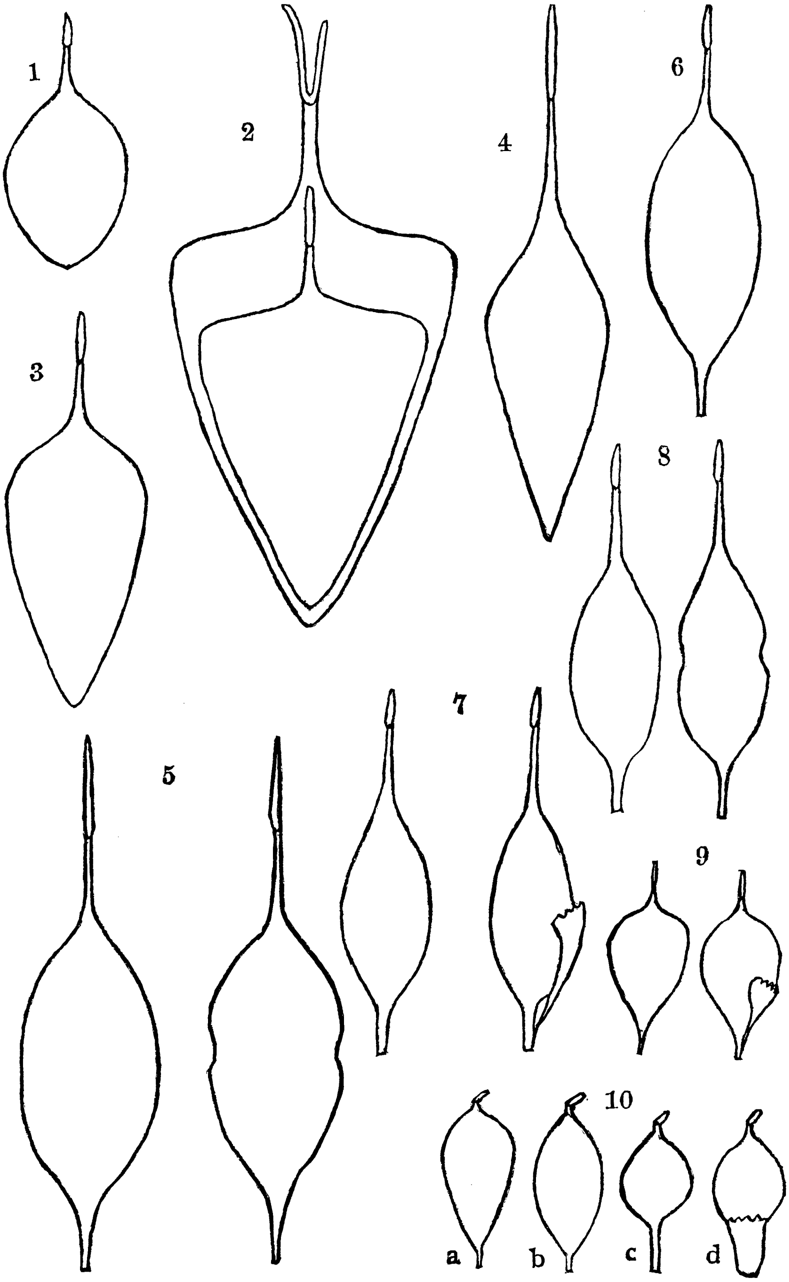

Fruit of various species of Sparganium. Thomas Morong.

Studies in the Typhaceæ.

BY THOMAS MORONG.

II.—SPARGANIUM.

Plate LXXIX.

Taking the three orders, Aroideæ, Typhaceæ and Pandaneæ, as the descendants of a common ancestor, to which, among surviving species, *Arum* bears the greatest likeness, *Sparganium* and *Pandanus* appear to have diverged the most widely of all the groups. Indeed, as Sir J. D. Hooker observes, the two might, were the inflorescence alone considered, be regarded as belonging to the same genus. In aspect and habit, however, they differ greatly, and *Sparganium* still retains the monœcious character of *Arum*.

The floral leaves or bracts of *Sparganium*, referred to in a previous paper as the representatives of the former spathes, are variously situated as regards the heads. Some of them are immediately underneath, and others remote from the heads, while in other cases the heads stand upon peduncles. The uppermost, which subtend the staminate heads, are small, thin and caducous, like the spathillas in *Typha*, or, at the extremities of the inflorescence, obsolete.

The perianth is composed of scales which have a linear limb somewhat broader at the base and spreading at the summit into a flat, rounded or spatulate, dentate apex. The male flowers are apparently arranged in clusters that consist of five stamens on thread-like filaments with about three scales intermixed, the scales thus occupying a place similar to that of the male bracts in *Typha*.

CORRECTIONS.—In the paper on *Typha* in the January number of the BULLETIN, 1888, on p. 6, under the figures of *T. angustifolia*, No. 6 is erroneously printed "*style;*" it should be "*stigma.*"

On p. 5, in the table of classification, under B II., is quite a serious error. The heading should read "Stigmas linear, female flowers *with* bracts," not, as printed, "*without* bracts."

My attention has also been called by a friend to the statement on p. 3, third line from the bottom, " setæ girding the base of the stipe " as being inconsistent with the figures delineated, which represent the setæ as running up the whole length of the stipe. It would have been more accurate had I said that the setæ which are, for the most part, attached to the lower portion of the stipe, frequently run nearly up to the ovaries in clusters. The figures were drawn from examples of the latter kind. in which the ovaries occur a considerable distance up the stipe : they are often low down.

In the female heads the scales are larger than in the male heads, and form a well marked calyx, from four to seven being attached to a single flower. The normal number of pistillate scales is four or five, corresponding with the number of the angles on the fruit, but often two or three others occur outside of these.

The pollen consists of single grains which are globular, with a smooth surface, and very similar to those of *Typha angustifolia*, being in *S. eurycarpum* $\frac{1}{1000}$ to $\frac{1}{800}$ inch in diameter, and somewhat smaller in *S. simplex*.

The stigmas are unilateral, lying along the upper portion of the style for a considerable distance from the apex. When the style is cleft, as is often the case, both divisions bear stigmas on the ventral side, and when the style is simple the stigmatic portion is on the upper side. The simple styles as they project from the heads curve slightly upwards so that the pollen falling from the anthers is more easily caught by the stigmas.

Most of the species bear double stigmas, either frequently or occasionally, and, of course, in such the ovaries are two-celled and two seeds are formed. One of them, however, is generally suppressed by abortion so that the perfected fruit is single. The number of stigmas, therefore, is not a safe character to use in specific distinctions, except when taken in connection with other characters. The length of the stigmas, also, is variable, even in the same form, and but little reliance can be placed upon it in classification. The fruit-characters must form our chief ground of distinction in any accurate determination of the species.

These points should be kept in mind in estimating the attempt made in this paper to classify the members of this genus comprehensively. I am not aware that any effort has been made to do this heretofore. Dr. Geo. Engelmann, whose lamented death has left a large void in our list of American naturalists, divided most of the North American species into groups for the 5th edition of Gray's Manual; but his division is, of course, limited, and founded upon subordinate characters. The summary now presented is based upon an examination of our North American forms, all of which, so far as known, have been carefully studied. Some of the foreign species, however, are not contained or not well represented in any trans-Atlantic herbarium, and consequently this summary must be considered as, to a certain degree, provisional, which a broader knowledge of the species may modify.

I have been compelled reluctantly to differ from Dr. Engelmann as to the relations and proper names of some of the forms. It does not seem to me possible to include *S. androcladum* under *S. simplex* as a variety, although they are undoubtedly closely allied. Not only does the former reach stouter proportions, but its inflorescence is branching, and sometimes almost as widely branching as that *S. eurycarpum*, and its fruit is larger and coarser. Besides this, *S. androcladum* is more aquatic in its habits than the other. I was fortunate enough during the last summer to light upon a very interesting proof of the relationship existing between this form and the deep water plant known as *S. simplex*, *var. fluitans*, *Engelm.* On the edges of a pond in the neighborhood of my home, and in several widely separated localities, *S. androcladum* grew in abundance. From the banks the plants ran down into the water until they reached a depth of four or five feet, the leaves gradually increasing in length and thinness and finally becoming floating, while the stems became more and more slender, and the inflorescence, which ceased at a depth of two or three feet, manifested a decided approach to the "*fluitans*" condition. This was not a case of submergence by flood, as the water was lower than usual by several feet, showing that the plants sought the water spontaneously. One step further and the plant becomes so much altered as to appear quite distinct from the parental form, warranting us in distinguishing it as a variety.

Nor am I able to agree with Dr. Englemann in regarding the distance of the floral leaves from the pistillate heads, or the proportionate length of the styles and stigmas as affording good varietal distinctions, these variations being very common and very inconstant. Judging by them alone, I have been continually perplexed to decide what is *S. simplex type*, and what "v. *Nuttallii*," what "v. *fluitans*," and what "v. *angustifolium*."

In separating the species, the simple or branching inflorescence might at first view seem to sufficiently designate the larger groups, but such a grouping is unnatural as it associates species which in reality are quite dissimilar. A more natural character is found in the shape and basal termination of the fruit. The form of the inflorescence may be used subordinately, after this the comparative number of the stigmas, and finally the terrestrial or floating habit, and the size of the fruit and styles.

Embodying these principles I am led to adopt the following classification, and to give afterwards a more detailed description of the American forms.

A.—FRUIT SESSILE AND COMPARATIVELY BROAD.

I.—INFLORESCENCE SIMPLE.

S. subglobosum.

II.—INFLORESCENCE BRANCHING.

1. Stigmas commonly 2, occasionally 1.
   S. eurycarpum, Engelm.
2. Stigmas commonly 1, occasionally 2.
   S. ramosum, Curtis, *S. Greenei*, *S. neglectum*, Beeby.

B—FRUIT STIPITATE AND COMPARATIVELY NARROW.

I.—STEMS ERECT OR FLOATING, INFLORESCENCE BRANCHING.

S. androcladum, Eglm.; var. *fluctuans*. Possibly the true *S. natans* of Linnæus and Fries belongs here.

II.—INFLORESCENCE SIMPLE.

1. Erect or floating, styles and fruit conspicuous, leaves triangular except when floating.
   S. simplex, Huds., var. *angustifolium*, (Michx.), Engelm. *S. fluitans*, Fries, if really a distinct species, would belong here, but perhaps it is nothing more than a form of *S. simplex.*
2. Usually floating, stems very slender, fruit and styles small, leaves flat.
   S. minimum, Fries. *S. hyperboreum*, Læst.
   S. oligocarpon, Angstr., as figured and described in Fl. Dan. Supp., Tab. 172, might belong to *S. minimum* or *S. hyperboreum.* It seems to be very rare, and its rank not fully established.
   S. Greenei and *S. neglectum* are evidently transition forms, as the more sloping summit and narrower outline of their fruit show. (See Figs. 3 and 4 in the plate.)

The North American species are as follows:

1. *S. eurycarpum*, Engelm. (Gray. Man., Ed. 5, p. 481.)

The largest member of the family, 9dm.–15dm. high. Prof. E. L. Greene sends a specimen which he has named *S. Californicum*,* but which I am unable to separate from *S. eurycarpum*, which measures 26 dm. in height and the leaves over 26 dm. long. The heads are numerous on the widely branching inflorescence—the staminate from six to fourteen on a branch, the pistillate usually two and sessile or more commonly on peduncles 1½-5 cm. in length; when ripe the fruiting heads 2-3 cm. in diameter; mature nutlets thick, hard, 8-10 mm. long, irregularly and obtusely four to five angled, wedge-shaped, truncate at the apex, the top rounded, flattened or depressed, abruptly tipped with the style; scales as many as the angles on the fruit, and often several exterior ones, half as long as the fruit or more, expanding into a spatulate apex, which is commonly eroded on the edges.

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*Paper read before the Cal. Acad. Sci., Feb. 4, 1884, p. 4.

As stated by Dr. Engelmann in Gray, Man., Ed. 5, p. 481, this species has often been confounded with the European *S. ramosum*, Curtis, which does not occur in this country. It differs from that not only in the greater size of the plant, which would not be of much importance in itself, but in the magnitude of the fruit (as may be seen in fig. 2 in the plate, where the two are represented in contrast), and also in the number of the stigmas. *S. eurycarpum* differs still more widely from the European *S. neglectum*, the fruit of which is outlined in fig. 4.

Virginia to California and northward to Lower Canada. I have seen no specimens from our Southern States or north of Ontario.

2. S. GREENEI, n. sp.

Quite similar to *S. eurycarpum* in general appearance. Stem 9-15 dm. in height; inflorescence about 3½ dm. long, rather narrower in outline than in *S. eurycarpum*, and the branches rising at a sharper angle. Pistillate heads two on a branch and sessile, the staminate 10-17; ripe fruiting heads 15-23 mm. in diameter; nutlets fusiform, 9 mm. long by 5 broad, widest part a little more than a quarter of the length from the summit, obscurely angular, tapering to the base; about one third of the stigmas in a head are double and they are as long as the styles, and both together not far from 4¼ mm. in length; leaves similar to those of *S. eurycarpum*, triangular, channelled and partly clasping at the base and flattened towards the apex, the largest 12 mm. wide by 16 cm. long. The fruit is shown in fig. 3.

This interesting plant was collected by Prof. E. L. Greene, in Sept., 1887, at Olema, Marin Co., California. It gives me great pleasure to name it for the acute and enthusiastic botanist to whom we owe its discovery.

3. S. ANDROCLADUM, (Engelm.) (*S. simplex*, Huds., v. *androcladum*, Engelm., in Gray, Man., Ed. 5, p. 481. *S. ramosum*, Chapm. South. Fl., 443.)

Stems erect, slender, 2½-6 dm. high; the inflorescence 10-25 cm. long, usually close and narrow and bearing but few branches, but sometimes branching extensively. A specimen kindly given me by Dr. C. W. Swan, which was collected by Mr. L. L. Dame on the island of Nantucket, has seven branches and thirty-two heads, all but one of which are staminate. Pistillate heads three to seven, sessile or the lowest peduncled, axillary, or the peduncles and branches axillary; ripe fruiting heads 12-25 mm. in diameter; nutlets fusiform, the body 5-6 mm. long by 3 broad, usually smooth but sometimes obtusely angular at the summit, oftentimes contracted strongly in the middle; with a style and stigma 6 mm. long, the stigmas as long as or shorter than the styles, and occasionally double; stipe nearly 3 mm. long. The plant grows in bogs or shallow water. Sometimes intermediate forms between this and the following are found, reference to which is made on p. 75. This species, as well as *S. eurycarpum*, has often been confounded with *S. ramosum*.

Canada and New England to Florida, and northwest to Vancouver's Island.

Var. FLUCTUANS. (*S. simplex*, Huds., v. *fluitans*, Engelm. in Gray, Man., Ed. 5, 481, *non S. fluitans*, Fries.)

Floating in deep water, with long, slender stems and thin, flat leaves, 3-8 mm. in width. The inflorescence is usually short and close, 6-10 cm. long and 3 or 4 cm. broad, but sometimes quite long and slender, as in a specimen from New Brunswick, belonging to Prof. John Macoun, where the axis of the inflorescence and the lowest branch are each 15 cm. in length and only 2-5 cm. in breadth; ripe fruiting heads 8-12 mm. in diameter.

Much as I dislike to multiply synonyms, it seems necessary to change Dr. Engelmann's name of this plant, for two reasons; first, because it is allied to *S. androcladum* rather than *S. simplex*, and secondly, because Dr. E. named it "var. *fluitans*," under the impression that it is identical with *S. fluitans*, Fr.; but unless that species is something very different from the plants so called which are contained in our great Herbaria, or as described to me by European authorities, our plant is not the same, and it only creates confusion to employ the name.

Pennsylvania, White Mountain ponds and northward.

4. *S. simplex*, Huds. (Fl. Ang., Ed. 2, p. 401.)

Leaves more or less triquetrous, 5-8 mm wide; stems slender, erect, 1½-6 dm. high; inflorescence 5-20 cm. in length; staminate heads 4-6, pistillate 2-4, sessile or the lowest peduncled, supra-axillary or axillary (v *Nuttallii*, Engelm.); ripe fruiting heads 12-15 mm. in diameter; nutlets fusiform or narrowly oblong, obtusely angled at the apex, the body about 4 mm. long, more or less contracted in the middle; stigmas linear, equal to or shorter than the styles; stipe about 2 mm. long.

This is often found in a dwarf state with a stem only 10 or 12 cm. high, leaves short and 2 or 3 mm. wide, and the inflorescence 2 or 3 cm. in length.

Canada to the Middle States, California and northward to British Columbia. (Eu.)

Var. MULTIPEDUNCULATA, n. var,

A form sent from Great Falls, Montana, by Mr. R. S. Williams, which has the heads aggregated, most of them on simple or branching peduncles; nutlets very slender and long-beaked; scales long, slender and toothed; and not infrequently double stigmas.

Var. *angustifolium*, (Michx.), Engelm., in Gray, Manual, Ed. 5, p. 481. (*S. angustifolium*, Michx., Flor. Bor. Am., ii., p. 189;* *S. affine*, Schnizl. Nat. Pfl. Typh., 1845, p. 27.)

Floating in deep water; stems slender; leaves long and narrow, 1-5 mm. wide, flat, with sheaths often inflated at the base; inflorescence 3-10 cm. long; staminate heads 1-4, pistillate 1-4, sessile, supra-axillary or the lower on supra-axillary peduncles, the lowest often remote as a peduncle 4-7 cm. in length; ripe fruiting heads 7-15 mm. in diam.; nutlets often contracted in the middle; stigmas linear or oval, equal to or shorter than the style. In European specimens of this which I have examined the inflorescence is sometimes as much as 20 cm. long, the lowest fertile head on a peduncle 10 cm. in length, but I have seen no American specimen equal to this. European specimens, also, sometimes have the lowest peduncle axillary, showing a variation in this respect. Mr. W. H. Beeby, of London, in a letter to the writer, suggests that our plant may be *S. simplex*, *v. longissimum*, Fries, which greatly resembles *S. affine*, Schnizl., and perhaps some of the forms included here may belong to that variety, a form with which I am unacquainted.

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*Dr. Engelmann writes in a manuscript note in my possession that he, himself, has seen Michaux's specimen at Paris. To this name, therefore, belongs the right of priority.

As stated by Engelmann, this plant sometimes occurs in dwarf states, growing nearly out of water, with shorter erect leaves.

Mountain lakes and slow streams, New York, New England and northward, also California and Washington Territory. (Eu.)

5. *S. minimum*, Bauhin. (C. Bauhin, pin. 16 Raji, Herb. Norm. XII., n. 71. Fries, Summa veg. Skand., p. 68, 1845. Called *S. natans* by most of the older writers, but not the true *S. natans* of Linnæus.)

Stems more slender than any of the preceding, varying in height according to the depth of the water in which it grows, 1-10 dm.; leaves thin and lax, 1-5 mm. in breadth; inflorescence 15-40 mm. in length; staminate heads 1 or 2, pistillate 1-3, sessile and axillary, or the lowest on an axillary peduncle 3-20 mm. long; ripe fruiting heads 5-10 mm. in diameter; nutlets top-shaped, (vid. fig. 9) 2½-3½ mm. long, or sometimes elongated to 4 mm.; stipe ½-1 mm. long, or now and then apparently none; styles about 1 mm. in length, of which the oval stigma occupies from ⅓ to ½.

The flowers usually rise to the surface in order to effect fertilization, but sometimes this appears to be done and the fruit perfected when submerged. Occasionally dwarf plants are found growing erect out of the water.

Pennsylvania and New England to Canada and northward; also westward to Oregon and Washington Territory. (Eu.)

6. *S. hyperboreum*, Læst. (In Wikst. Arsberätt, 1850.)

Stem similar to that of *S. minimum*, 20-30 cm. high; leaves usually shorter and narrower, 1-3 mm. broad; inflorescence only 15-25 mm. in length; staminate heads 1 or more, pistillate 1-2, sessile or the lower on a short peduncle which is often supra-axillary; ripe fruiting heads 5-10 mm. in diameter; nutlets oblong, obscurely triangular at the summit; stipe very short; the oblique, oval stigma minute and sessile, or nearly so.

All the North American specimens which I have seen bear imperfect seeds which are so much contracted on the lower half as to appear flat. Outlines of these are given in fig. 10 in the plate, c. exhibiting the thin edge and d. the flat side of the contraction. This species seems much addicted to this imperfection, as in Herb. Gray are quite a number of European specimens showing the same malformation. a. and b. exhibit perfect seeds from European specimens. The fruit of the American plant seems a trifle smaller than that of Europe.

In the drawing there is more of a style represented than there should be, and the stigma is a little too oblique.

Southern Shore of Hudson Bay. J. M. Macoun. Labrador. J. A. Allen. According to Lange (Consp. Fl. Grœn., p. 116), this plant has been collected in Greenland. (Eu.)

To the above should be added an undescribed species from New Zealand, contained in Herb. Asa Gray, which I have called S. SUBGLOBOSUM. It appears to be a floating species, the stem nearly 3 dm. high; leaves longer than the stem, 2-4 mm. wide, in texture much like those of *S. androcladum*, var. *fluctuans;* the simple inflorescence is short, consisting of two pistillate heads which are sessile and axillary; staminate heads lacking on the specimen, but apparently were only two; ripe fruiting heads 8-10 mm. in diameter; fruit subglobose, obscurely angular at the summit, not quite 4 mm. long. by 3 mm. broad; stigma oval, about one-third as long as the style. (See fig. 1.)

The specimen is erroneously labelled "*S. simplex*, Huds., v. *angustifolium*, Engelm."

Coll. at Bay of Islands, N. Zealand, in the U. S. Exploring Expedition under command of Capt. Wilkes.

Explanation of the Plate.

The figures show the fruit of different species, all X 5. 1. *S. subglobosum.* 2. *S. eurycarpum*, enclosing *S. ramosum.* 3. *S. Greenei.* 4. *S. neglectum.* 5. *S. androcladum*, one nutlet showing constriction. 6. *S. androcladum*, var. *fluctuans.* 7. *S. simplex*, one nutlet showing a scale. 8. *S. simplex*, var. *angustifolium*, one nutlet showing constriction. 9. *S. minimum*, one nutlet showing a scale. 10. *S. hyperboreum;* a and b, perfect seeds from European specimens; c and d, imperfect seeds from American specimens; c showing the thin edge, and d the flattened side of the lower half.